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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or Relating to Methods of Riveting and Tubular Rivet Fastenings For Use Therein and in Tools For Use Therewith

We, G. K. N. SCREWS & FASTENERS LIMITED, a British Company, of Heath Street, Smethwick, Warley, in the County of Worcester, formerly of Heath Street, Birmingham, in the County of Warwick, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement: —

This invention relates to a method of riveting using a tubular rivet for joining together two or more sheets or plates (both hereinafter referred to as "sheets"). Such tubular rivets are particularly useful in blind side applications where sheets are to be joined together and it is not possible to obtain access to the remote side of the sheets so that the operation of applying the fastening has to take place from the front side.

Such tubular rivet fastenings as used hitherto have comprised, in combination, a tubular rivet having a tubular body and at one end thereof an enlarged flange or other form of abutment member adapted to engage the exposed face of one of the sheets to be joined on the front side and a mandrel which is used to insert the rivet through prepared aligned drilled holes in the sheets which are to be joined. In such combination the mandrel has an enlarged head on its forward end and the tubular rivet is positioned behind this head so that the mandrel with the rivet in position can be passed through the prepared holes until the flange or other abutment on the rivet engages the exposed face of one of the sheets to be joined. With the rivet being held against axial withdrawal the mandrel is pulled outwardly through the rivet with the result that the enlarged head of the mandrel engaging the end of the rivet causes this end to expand or bulge outwardly to a transverse dimension greater than the diameter of the prepared hole so as to lock the rivet firmly in position.

Subsequently, the portion of mandrel projecting outwardly from the front of the rivet is broken off or the mandrel may be such that it breaks off under a predetermined tension at a position inside the rivet and the portion of the mandrel left on the blind side may be knocked inwardly so that it drops out of the inner end of the rivet. In some cases the head of the mandrel is so shaped that it locks itself within the expanded wall of the rivet and remains permanently in position when broken away from the remainder.

Hitherto the use of a mandrel and rivet fastening as above referred to has required the drilling or punching of the holes in all the sheets being fastened and this entails the expense of separate operations and furthermore difficulties may be encountered in accurately aligning the holes in the sheets when they are brought together.

An object of the present invention is to reduce or eliminate these preliminary operations.

According to the invention we provide a method of riveting two sheets together comprising the steps of providing a tubular rivet having a tubular body and an enlarged flange at one end, providing a mandrel having a shank, and a head at the end of the shank, said head having an aperturing means provided thereon, and having a maximum diameter greater than the shank diameter, plac-

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ing the rivet about the shank of the mandrel with the flange of the rivet remote from the head of the mandrel, advancing the shank of the mandrel to cause the head to form an aperture in at least one of the sheets to be joined, moving the rivet axially into said aperture until the flange of the rivet engages the exposed surface of the sheets, applying a force in the opposite direction to the direction of advancement to withdraw the mandrel causing the enlarged head to expand the end of the rivet radially outwardly.

A further object of the invention is to provide a new or improved rivet fastening for use with the new or improved method.

Also according to the invention we provide a tubular rivet fastening comprising a tubular rivet having a tubular body the passage therethrough being of constant circular cross-section through and the body having an enlarged flange at one end thereof, and a mandrel, the mandrel having a shank and, on the end of the shank, a head having a maximum diameter which is greater than the internal diameter of the tubular body of the rivet, the head of the mandrel merging into the shank by means of an abutment surface which makes an acute angle with the axis of the shank and the head of the mandrel being formed with an aperturing means at its extremity.

The phrase "aperturing means" as used herein should be construed as means formed or provided on the head of the mandrel capable of forming an aperture in a sheet, such as a metal sheet, upon appropriate manipulation of the mandrel, for example, such an aperturing means may be a piercing point.

With the arrangement above defined, the rivet is mounted upon the mandrel behind the head and then the assembly of mandrel and rivet is driven through one or both of the sheets to be secured together with the piercing point on the head of the mandrel forming the required hole or holes by a piercing action so that the rivet follows through the hole pierced by the head. Subsequently, withdrawal of the mandrel causes outwards splaying of the inner end of the rivet owing to the engagement between this end and the aforesaid abutment surface on the mandrel.

A still further object of the invention is to provide a new or improved tool for carrying out the new or improved method, which tool can operate to deliver an impact to the mandrel to drive the mandrel and rivet through a sheet and can also act to retract the mandrel to deform the rivet and make a secure fastening.

According to the invention there is provided a tool for carrying out the new or improved method comprising a body having a holder mounted in or on said body, said holder having a forward end provided with means for gripping the rear end of the mandrel of a rivet and mandrel fastening, means for driving said holder so as to cause the aperturing means on the mandrel to form a hole in a sheet, and means to cause the holder to move in the direction to retract the mandrel and cause breakage of the mandrel.

According to a more specific aspect of the invention there is provided a tool for carrying out the new or improved method, comprising a body, having a holder reciprocably mounted in or on said body, said holder having a forward end provided with means for gripping the rear end of the mandrel of a rivet and mandrel fastening, an impact member mounted in or on said body, a means for driving said impact member with a forwards and rearwards motion to cause the impact member to deliver an impact to the holder to drive same forwardly and to cause the mandrel to penetrate a sheet and also to cause the impact member to move in the opposite direction to retract the holder and cause breakage of the mandrel.

Conveniently the tool is in the form of a gun having a cylindrical body and the holder may be in the form of a spindle arranged co-axially within the body, with the impact member taking the form of a piston adapted to be moved by fluid pressure, such as compressed air.

Conveniently the impact member may be a free piston slidably mounted on the aforesaid spindle and operating between two abutment surfaces of the spindle to deliver the impact in the forwards direction and to apply retractive force in the rearwards direction.

The forward end of such shaft may be of tubular form to form a housing for a collet for gripping the mandrel of the rivet and mandrel fastening and on the retraction stroke of the spindle there may be provided means such as a dash-pot for decelerating the spindle to provide for a slow pulling or deforming of the rivet.

The invention is illustrated in the accompanying drawings wherein: —

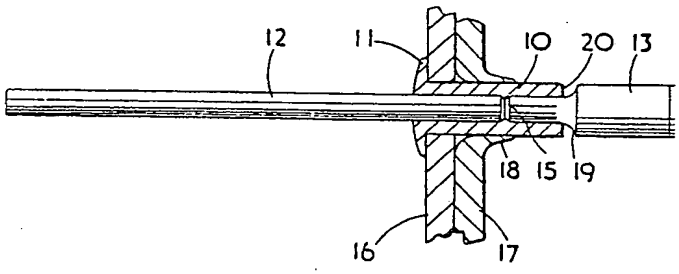
FIGURE 1 is a diagrammatic view showing a certain stage in the method of application of a tubular rivet, this being the stage where the mandrel has pierced a hole in the two sheets and the rivet has been inserted in the hole prior to withdrawal of the mandrel.

FIGURE 2 is a view showing the final stage in the method where the mandrel has been withdrawn and the head of the mandrel broken from the shank.

FIGURE 3 is a longitudinal cross-section through one form of tool for carrying out the new or improved method.

In the embodiment illustrated in the drawings the rivet is of substantially the same form as known hitherto with the exception

Fig.1.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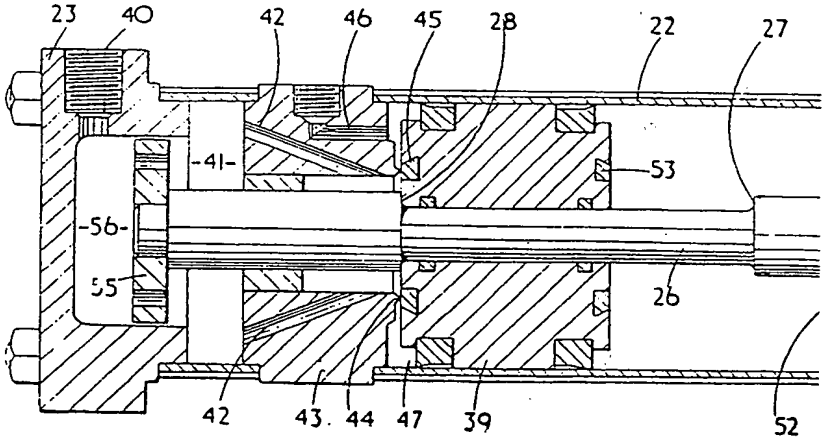
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angle with the axis of the shank and the head of the mandrel being formed with an aperturing means at its extremity.

5. A rivet fastening as claimed in claim 4, wherein the aperturing means is a piercing point.

6. A rivet fastening as claimed in claim 4 or claim 5, wherein the shank of the mandrel is provided with a portion of reduced cross-section to define a weakened neck.

7. A tool for carrying out the method as claimed in any one of claims 1 to 3, comprising a body having a holder mounted in or on said body, said holder having a forward end provided with means for gripping the rear end of the mandrel of a rivet and mandrel fastening, means for driving said holder so as to cause the aperturing means on the mandrel to form a hole in a sheet and means to cause the holder to move in the direction to retract the mandrel and cause the breakage of the mandrel.

8. A tool for carrying out the method as claimed in any one of claims 1 to 3, comprising a body, having a holder reciprocably mounted in or on said body, said holder having a forward end provided with means for gripping the rear end of the mandrel of a rivet and mandrel fastening, an impact member mounted in or on said body, a means for driving said impact member with a forwards or rearwards motion to cause the impact member to deliver an impact to the holder to drive same forwardly and to cause the mandrel to penetrate a sheet and also to cause the impact member to move in the opposite direction to retract the holder and cause breakage of the mandrel.

9. A tool as claimed in claim 8, wherein the tool is in the form of a gun, said body being cylindrical, said holder being in the form of a spindle arranged co-axially within said cylindrical body and said impact member comprising a piston adapted to be moved by fluid pressure.

10. A tool as claimed in claim 9, wherein the impact member is a piston mounted to slide freely on said spindle between two abutment surfaces formed thereon so as to deliver impact in the forward direction and to apply retractive force in the rearwards direction.

11. A tool as claimed in claim 10, wherein the forward end of said spindle is of tubular form to form a housing for gripping the mandrel of the rivet and mandrel fastening.

12. A tool as claimed in claim 11, wherein means are provided for decelerating said spindle to provide for a slow pulling or deforming of the spindle.

13. A tool as claimed in claim 12, wherein the means for decelerating said spindle is a dash-pot.

14. A method of riveting two sheets together substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

15. A tubular rivet fastening substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

16. A tool substantially as hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings.

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in the member 43 and communicating with the annular space 47 to the rear of piston 39.

Near the forward end of the body there is provided a sleeve 48 similar to sleeve 43 and air under pressure entering via a suitable connection 49 into the chamber 50 passes via passages 51 to the forward face of the piston and there is an arrangement of annular sealing lip 52 adapted to engage a sealing ring 53 in the forward face of the piston similar to the lip 44 and ring 45 when this is in its forward position after an impact has been delivered.

Similarly to the exhaust vent 46 there is provided in the member 48 an exhaust vent 54 for the purpose hereinafter described.

The rear end of the spindle 26 is fitted with a perforated piston disc 55, which works operatively in the chamber 56 in end cap 23 for the purpose of providing a dash-pot retardation of the spindle 26 on its retracting stroke.

In the operation of the tool with the parts in the position shown in Figure 3, the mandrel 31 is held in the jaws 35 of the collet and piston 39 at the rear end of its stroke with its sealing ring 45 in sealing engagement with the annular lip 44. Air under pressure occupies the chambers 41 and 50. Air is then exhausted from chamber 50 and after a short lapse of time of about $\frac{1}{2}$ second, the pressure on the rear face of the piston within the sealing ring 45 is sufficient to enable air to leak past the sealing lip 44, so that the compressed air then acts upon the full surface area of the rear face of the piston and causes rapid acceleration of the piston along the spindle 26, so that it delivers an impact to the shoulder 27, with a resultant impact delivered via the abutment strip 36 to the mandrel 31 to cause its pointed end to piece the metal sheet.

During this movement of the piston air is swept from the space in front of the piston via the passages 51 and also via the passage 54 which prevents any build-up of pressure of the air trapped in the annular space surrounding the sealing lip 52 when the sealing lip 53 makes engagement therewith at the end of the forward stroke.

The controls of the tool are then operated in the reverse direction to apply air under pressure to the forward face of the piston via inlet 49 and passage 51 and rear face via inlet 40 and a similar action results with air being exhausted from chamber 41 until the air leaks past the sealing lip 52 and delivers a rapid impact to the forward face of the piston 39, driving this in a rearwards direction and causing it to deliver an impact to the spindle 26 via the shoulder 28 to cause retraction of the mandrel. The arrangement of piston disc 55 in the chamber 41 acts as a dash-pot to retard the last part of the rearwards movement of the spindle 26 so that a slower pulling action is applied by the mandrel to the rivet to deform its end in the manner shown in Figure 2.

Finally the mandrel is caused to break off due to the tension created therein on the retracting stroke of the spindle 26. The exhaust vent 46 acts in the same manner as the exhaust vent 54 to prevent build-up of pressure of air trapped in the annular space 47 when the piston reaches its rearward end of its stroke.

WHAT WE CLAIM IS:—

1. A method of riveting two sheets together, comprising the steps of providing a tubular rivet having a tubular body and an enlarged flange at one end, providing a mandrel having a shank, and a head at the end of the shank, said head having an aperturing means provided thereon, and having a maximum diameter greater than the shank diameter, placing the rivet about the shank of the mandrel with the flange of the rivet remote from the head of the mandrel, advancing the shank of the mandrel to cause the head to form an aperture in at least one of the sheets to be joined, moving the rivet axially into said aperture until the flange of the rivet engages the exposed surface of the sheets, applying a force in the opposite direction to the direction of advancement to withdraw the mandrel, causing the enlarged head to expand the end of the rivet radially outwardly.

2. A method of riveting two sheets together, as claimed in claim 1, where only the sheet remote from the sheet against which the flange of the rivet engages is apertured by the aperturing means of the mandrel, the sheet adjacent the flange of the rivet being provided with a preformed aperture in alignment with said aperture in said sheet remote from the sheet adjacent the flange of the rivet.

3. A method of riveting two sheets together, as claimed in claim 1 or claim 2, wherein said aperturing means is a piercing point, and wherein the mandrel is advanced by delivering an impact to the shank of the mandrel to cause the head to pierce an aperture in the sheet or sheets.

4. A tubular rivet fastening for use with the method as claimed in any one of claims 1 to 3, comprising a tubular rivet having a tubular body the passage therethrough being of constant circular cross-section throughout and the body having an enlarged flange at one end thereof, and a mandrel, the mandrel having a shank and, on the end of the shank, a head having a maximum diameter which is greater than the internal diameter of the tubular body of the rivet, the head of the mandrel merging into the shank by means of an abutment surface which makes an acute

that its axial length would be slightly greater than the corresponding length of a standard tubular rivet for the reason hereinafter mentioned. The rivet has a tubular body 10 and an enlarged flange 11 at one end.

The mandrel has a shank portion 12 which is in the form of a short length of rod and at one end an enlarged head 13 which is formed so as to provide a piercing point 14 at its extremity. This point may be of any suitable form and may vary in accordance with the material of the sheets in which the rivet is to be secured. For example, it may be an ogive point or it may be a point of pyramid formation.

The abutment surface between the shank 12 of the mandrel and the portion of maximum diameter of the head 13 is arranged so that it provides a surface 19 making an acute angle with the axis of the shank. As shown this abutment surface may take the form of a generous fillet which merges the shank 12 into the maximum diameter portion of the head 13.

In the case of securing two sheets together as at 16 and 17, the front sheet 16 may be provided with a prepared hole or the mandrel may be used to pierce the hole in both sheets. In either case no operation of actual aligning two prepared holes is necessary and at most only one prepared hole needs to be provided.

With the rivet in position on the mandrel the shank 12 of the mandrel is driven by means of the tool hereinafter described to cause the pointed head of the mandrel to pierce a hole or holes through the sheets to be joined, and as the maximum diameter of the head 13 is at least equal to the external diameter of the tubular body 10 of the rivet the hole or holes thus pierced will permit the rivet to pass through until its flange 11 engages the exposed surface of the front sheet 16, as shown in Figure 1. When an axial force is applied to the mandrel to withdraw it, with the rivet held against axial withdrawal, the engagement between the abutment surface 19 of the mandrel and the end face 20 of the tubular rivet results in this end of the rivet being deformed so as to splay outwardly as shown at 21 in Figure 2 to lock the rivet firmly in position.

As the piercing operation will result in some metal being upset around the edge of the pierced hole (see 18) it is necessary that the axial length of the rivet should be sufficient to ensure that when its inner end is splayed over it will engage over the portion 18. Thus, in length, the rivet according to the invention should be slightly greater than the standard form known hitherto for any particular application.

The mandrel shank is provided with a portion 15 of reduced cross-section which forms a weakened neck so that on application of a predetermined tension during the withdrawal of the mandrel the shank fractures at the neck 15 and as shown the head 13 drops down on the blind side of the two sheets. If desired the head may be shaped so that it enters the bore of the rivet before such fracture takes place and remains firmly locked in place inside the rivet, but without any portion of its shank projecting beyond the flange end 11 of the rivet.

The new or improved tool for applying this fastening is shown in Figure 3 and comprises a cylindrical body 22, having an end cap 23 at one end and a housing 24 at the other end, connected to the body 22 through the medium of the intermediate part 25. Slidably mounted within the body 22 is a spindle 26 provided with two enlargements forming shoulders 27 and 28 near its rearward end and at its forward end having an externally screwed extension 29 on to which is screwed a tubular member 30 forming a housing for a collet which grips the mandrel 31 of the mandrel and rivet assembly shown at 32.

The collet comprises a pair of resilient metal arms 33, secured at their rearward ends to a block 34, slidably mounted inside the tubular housing 30 and each being secured at its forward end to one of the two jaws 35 of the collet. It will be observed that the spring arms 33 are in spaced parallel relationship and an abutment strip 36 extending across the tubular housing 30 and fixed therein forms an abutment for the rear end of the mandrel 31 and also serves to deliver the impact to the mandrel as hereinafter described. The collet arms 33, jaws 35 and block 34 collectively form a holder for the mandrel.

A coil spring 37 operates between the block 34 of the collet and the forward end of the screwed extension 29 to normally urge the collet in the forwards direction in which its tapered jaws 35 grip the mandrel due to their wedging engagement with the interiorally tapered forward end 38 of the housing 30.

The impact member comprises a free piston 39 slidably mounted upon the spindle 26 between the abutment shoulders 27 and 28 and the compressed air for operating such piston is delivered to the gun in the following manner.

A suitable connector 40 conveys air under pressure to the chamber 41 via the end cap 23 and from there to the rear face of the piston 39 via passages 42 in a sleeve 43 fixed in the body of the gun, said sleeve having a central opening of a larger diameter than the spindle 26 and being provided with an annular sealing lip 44 around said opening, engaged sealingly by a sealing ring 45 fitted in the rear face of the piston. There is also an exhaust vent 46 provided

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 2.

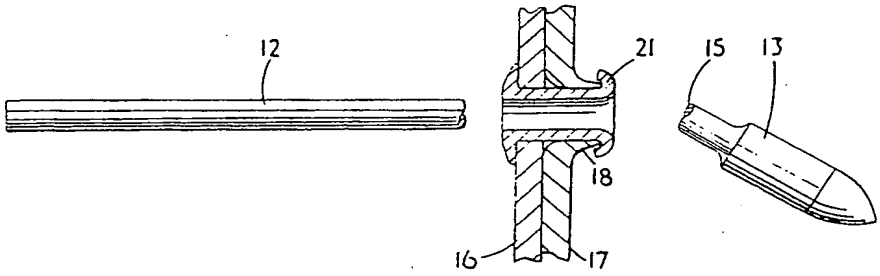
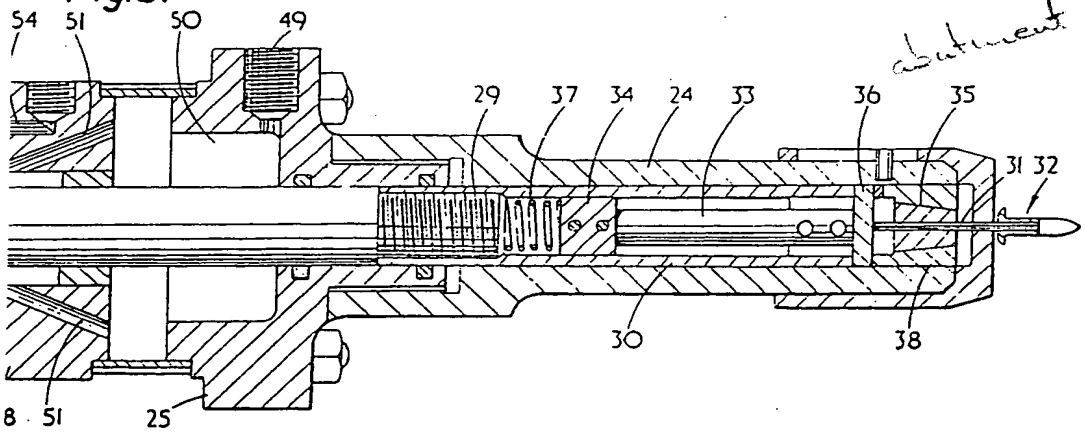


Fig. 3.



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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig.1.

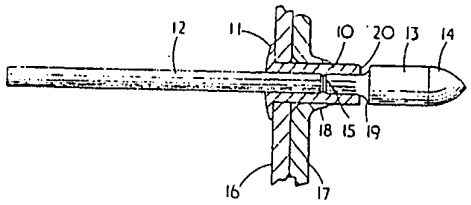

Fig.2.

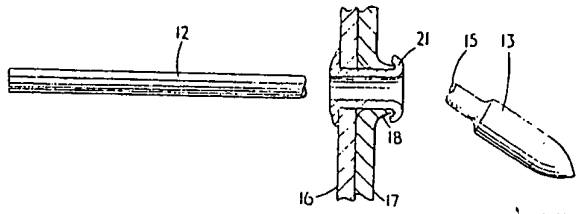

Fig.3.